

Rural Wellhead Protection Fact Sheet

PLUGGING ABANDONED WELLS

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INTRODUCTION

The integrity of groundwater aquifers must be maintained and protected to preserve our groundwater resources. This goal can be aided by properly plugging abandoned or old wells based on knowledge of the well site's soils and geology.

Many ranches, farms, or rural properties contain old or abandoned water wells that are no longer in use. If these abandoned water wells are not properly sealed, they can provide a direct conduit for surface water carrying pollutants to groundwater. Proper plugging of water wells restores barriers to contamination, removes physical hazards by closing off tempting openings for curious children and animals, and removes liability while improving or protecting property values.

TYPES OF AQUIFERS

The type of aquifer tapped by a water well should be known if the well is to be properly plugged. When water from the surface infiltrates directly down into an aquifer, the aquifer is called an **unconfined** aquifer. A second type of aquifer, the **confined** aquifer, is overlain by an impermeable layer that prevents direct local recharge from the surface. Water in a confined formation is under pressure that is greater than atmospheric pressure, and therefore rises in the wellbore to a level above the top of the confined aquifer. Confined aquifers are sometimes referred to as artesian aquifers. When a water-bearing layer is made up of individual, uncemented grains of sand or gravel, the aquifer is called **unconsolidated**. All other types are considered consolidated or **bedrock** aquifers. Consolidated and bedrock aquifers may be unconfined or confined.

Most aquifers are more complex than this explanation. Confining layers in aquifers are particularly important because they separate the aquifer into zones. An aquifer may have several water bearing zones separated by confining layers of varying permeability. Each zone may have a different yield and water quality.

Well logs and other information about well construction may be available from the State Engineer's Office or local water well drillers. If the original well log is not

available, logs of other wells drilled on the property or the neighboring properties may aid in determining the geologic formations penetrated. Geological or groundwater reports may be available in the local library or at various State or Federal agency offices. (Contacts are listed at the bottom of this fact sheet).

TYPES OF WELLS

Understanding water well construction methods is important because different types of wells require different plugging procedures. **Dug wells** are typically relatively shallow, large diameter, hand-dug wells, usually lined with brick, wood, or rock. A **driven well** is constructed by driving the screened section of the well casing into the water-bearing formation. These wells are generally of small diameter, with pipe diameters ranging from one to six inches. They are most common in sandy areas with shallow unconsolidated aquifers, where centrifugal or jet pumps can be used. The **drilled well** is the most common type of well used in Wyoming. In a drilled well, casing is typically inserted after the borehole is drilled by rotary, cable tool, or other drilling method. The annular space between the casing and the borehole wall is filled with gravel. This gravel pack allows unrestricted water flow into the perforated portion of the casing and acts as a filter to keep fine aquifer particles from entering the well. Near the ground surface the annular space is filled with cement grout to prevent infiltration of water into the well along the outside of the casing. Unfortunately, it is a common practice to gravel pack the annular space to very near the ground surface to induce the greatest yield and reduce costs. This practice allows surface water to enter the well by infiltrating down along the outside of the casing. This provides an easy pathway for contaminants to enter groundwater from the ground surface.

REQUIRED PLUGGING PROCEDURES

The Wyoming State Engineer's Office (SEO) administers regulations and instructions governing the construction and plugging of most types of groundwater supply wells (e.g., domestic, irrigation, stock). Current SEO policy and regulations are presented in the following section. The Wyoming Department of Environmental Quality, Water Quality Division (WDEQ/WQD) administers the

regulations and instructions governing the construction and plugging of public water supply wells.

SEO REGULATIONS AND INSTRUCTIONS

When any well, including any test well, is to be permanently removed from service, it must be destroyed to prevent the well from serving as a conduit that may allow vertical movement of water through an aquifer, or allow contamination of the ground water supply. An uncased well must be destroyed by filling it completely with grout, cement or concrete grout, drilling mud, or bentonite. Although drilling mud is an acceptable plugging material in the current SEO regulations, its use is not recommended.

When plugging procedures are completed, a report stating the date and method of plugging must be submitted to the SEO in Cheyenne. Upon receipt of the report, the permit/water right will be updated to show abandonment of the well.

Unconsolidated Formations

Cased wells in unconsolidated formations must be sealed by filling with grout, cement or concrete grout, or bentonite. The uppermost portion of the well must be filled by a cement or concrete plug near the ground surface.

Consolidated Formations

Wells in consolidated formations must be plugged by filling completely with grout, cement or concrete grout, drilling mud, or bentonite. Any section of the well intersecting cavernous or fractured rock must be filled with concrete or cement grout, or alternate layers of cement grout and gravel or stone aggregate. A concrete or cement plug must extend to at least 10 feet above the cavernous zone and 10 feet below the cavernous zone, or to the bottom of the well, whichever distance is less.

Artesian Wells

Artesian wells must be destroyed in such a manner that a cement or concrete plug completely seals the artesian aquifer and extends above the artesian zone for a minimum of 10 feet. This seal must also extend 10 feet below the artesian zone or to the bottom of the well, whichever distance is less. If necessary to stop surface or subsurface leakage from the artesian zone, the entire zone must be pressure grouted. The remainder of the well must be filled with grout, cement or concrete grout, drilling mud, or bentonite.

Gravel packed wells must be destroyed by pressure grouting the entire perforated or screened section of the

casing. The remainder of the well must be filled with grout, cement or concrete grout, drilling mud, or bentonite.

SUGGESTED PLUGGING PROCEDURES FOR WATER WELLS IN UNCONFINED-UNCONSOLIDATED AQUIFERS

The following steps discuss a suggested procedure for the proper sealing of an abandoned well in an unconfined aquifer in unconsolidated rock (**Figure 1**). These situations are commonly found in Wyoming. If your well has complex construction, please contact the State Engineer's Office or a drilling contractor for proper plugging procedures.

Step 1. Site Preparation - Remove all pumping equipment and debris from the well and around the well site.

Step 2. Disinfect - Any existing bacteria or bacteria carried to the water by the fill material should be destroyed. This will prevent contamination of nearby wells. Sufficient chlorine should be added to produce a solution in the well of approximately 200 milligrams per liter of chlorine. The **Well Maintenance Fact Sheet** describes procedures for disinfecting a well.

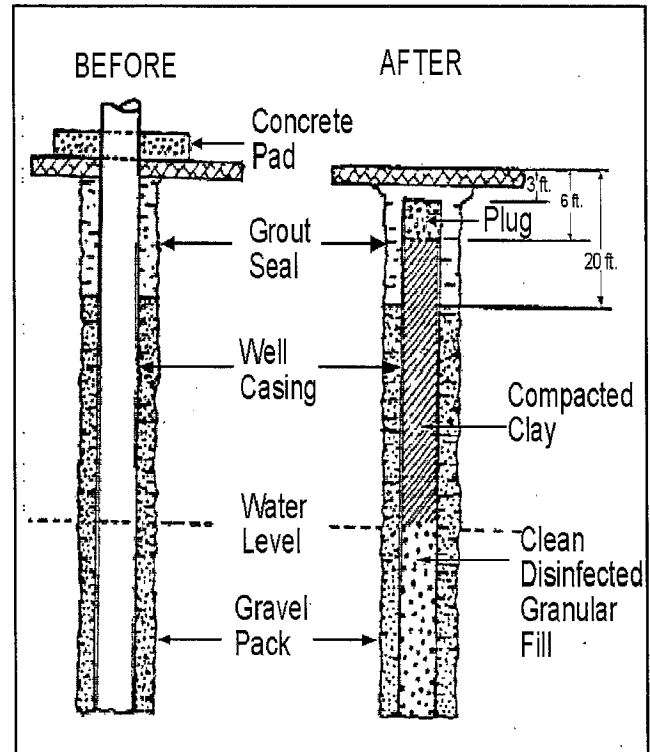


Figure 0. Plugging Diagram of Well With Proper Annular Grouting

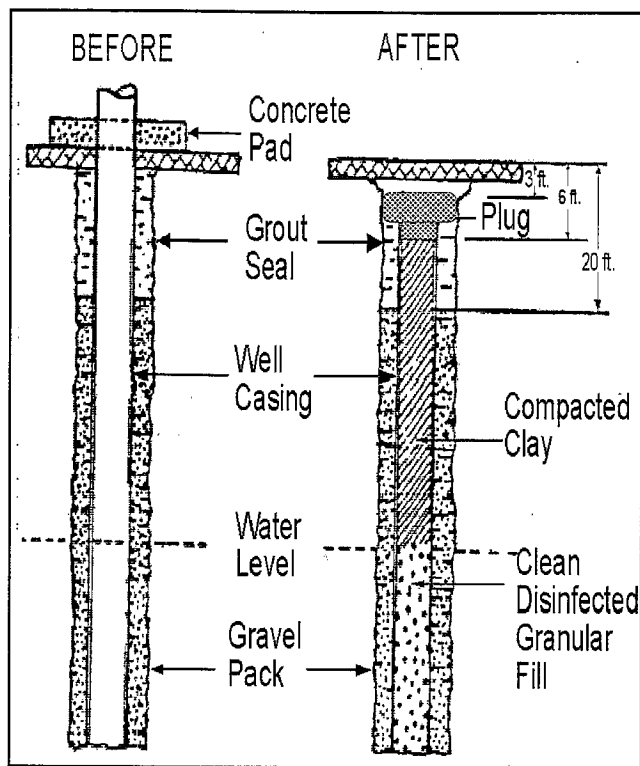


Figure 1. Plugging Diagram of Well Without Proper Annular Grouting

Step 3. Fill water-bearing portion of the well - The first fill material into the well is clean sand, which will be disinfected as it passes through the previously chlorinated water. First, the water level of the well should be measured. Then calculate the volume of sand needed and add only enough sand until the well is filled to the original water level.

Step 4. Plugging the non-water bearing portion of the well - The non-water bearing portion of the well should be filled with clay, bentonite or other low-permeable material and allowed to settle, forming a continuous column of material. This material should fill the well to within no more than 6 feet of ground surface.

Step 5. Placement of the plug material - Pour approved grouting material into the well. As illustrated in Figure 1 and Figure 2, the plug should be at least three feet thick.

Materials approved by the State Engineer's Office include grout, cement or concrete grout, and bentonite. Cement grout is a mixture of equal volumes of portland cement and sand. Five to six gallons of water should be used for each 94 pound bag of cement. Granular bentonite or bentonite chips are recommended for use

because they are easy to handle, remain pliable, and expand slowly when in contact with water.

Step 6. Removal of casing - Excavate around the casing to the top of the plug; the excavation should be approximately three feet deep. Cut off the casing and backfill the excavation with low permeability soils. The well now has the proper plugging materials in place.

You may discover when you excavate around the old casing that the well was never grouted properly. Establishing a proper surface seal is critical to preventing contaminants from migrating downward alongside the casing. When possible in wells without proper surface seals, the upper 10 to 20 feet of casing should be removed. This helps eliminate the problem of obtaining an adequate seal.

If the casing cannot be removed, two options are available. One is to excavate a space around the old casing at least 10 feet deep and pour an approved grouting material into the excavation. The second option, shown in Figure 2, is to extend the plug beyond the edges of the original bore hole at least 1½ feet beyond the casing. This mushroom plug will prevent water movement along the outside of the casing. Deeper excavation is desirable when no grouting exists outside the casing.

Contacts

Wyoming Department of Environmental Quality, Water Quality Division, 122 W. 25th St. 4W, Cheyenne, WY 82002, (307) 777-7781.

Wyoming State Engineer's Office, 122 W. 25th St. 4E, Cheyenne, WY 82002, (307) 777-7354.

Geological Survey of Wyoming, P.O. Box 3008, University Station, Laramie, WY 82071-3008, (307) 766-2286.

U.S. Geological Survey, Water Resources Division, 2617 E. Lincolnway, Cheyenne, WY 82007, (307) 772-2153.

University of Wyoming Water Resources Center, P.O. Box 3067, University Station, Laramie, WY 82071-3067, (307) 766-2143.

WELL PLUGGING

Proper plugging of water wells restores barriers to contamination, removes physical hazards by closing off tempting openings for curious children and animals, and removes liability while improving and protecting property values.

This worksheet is designed to accompany the **Well Plugging Fact Sheet**. After completing the worksheet, refer to the **Fact Sheet** to evaluate the threat of improperly abandoned wells at your ranch/farmstead.

1. Does your ranch/farmstead contain any abandoned wells that have not been properly sealed? ☐ yes ☐ no
2. Is your water supply well completed in the same aquifer as the abandoned well? ☐ yes
☐ no
☐ do not know
3. Where is the abandoned well located in relation to your water supply well? ☐ downgradient
☐ crossgradient
☐ upgradient
☐ do not know
4. Are any completion details available for the abandoned well? ☐ yes ☐ no
5. How was the abandoned well constructed? ☐ dug
☐ driven
☐ drilled
☐ do not know
6. In what type of aquifer is the abandoned well completed? ☐ confined
☐ unconfined
☐ (water table)
☐ artesian
☐ do not know
7. In what type of rock was the abandoned well completed? ☐ unconsolidated
☐ bedrock
☐ do not know
8. What is the depth to groundwater in the abandoned well(s)? ☐ feet
☐ do not know